

SURVIVAL RECORDS FOR ELMID BEETLES, WITH NOTES ON LABORATORY REARING OF VARIOUS DRYOPOIDS (COLEOPTERA)¹

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Because of their importance as indicators of water quality, dryopoid beetles are receiving increased attention (Sinclair, 1964; Brown, 1972). Despite the fact that elmids are the most abundant, diverse, and ecologically significant of the dryopoids, no one has yet described the complete life history of an elmid. Eggs are known only from dissected specimens, little has been published concerning larval instars, and few pupae have been identified (Bertrand, 1972). Knowledge of longevity of larval and adult stages and of pupal duration is almost entirely inferential, for no factual data have been published. Laboratory rearing will certainly play a significant role in providing much of the needed information.

In 1957, Cole reported "a surprising case of survival" involving an adult female specimen of *Stenelmis crenata* Say, which survived between 394 and 398 days in a 20 ml shell vial containing 3 ml of water and remaining tightly corked. So far as I am aware, Cole's record recounts not only the most surprising, but also the longest longevity record published concerning adult dryopoid beetles.

Colleagues have suggested that I publish some of my records, even though they are as yet incomplete since some of the specimens are still alive. One case is somewhat comparable to that reported by Cole, at least in that the specimens have been kept in quite a small container. An adult of *Macronychus* and a larval *Stenelmis* have survived well over 3 years. Details are as follows.

On October 19, 1969 I collected 2 adults of *Ancyronyx variegata* (Germar), 5 of *Macronychus glabratus* Say, and 21 larvae of *Stenelmis* from a submerged log in the east fork of the San Jacinto River near Cleveland, Texas. These were brought alive to my laboratory in Norman, Oklahoma, where they were placed in a

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small plastic jar (39 mm outside diameter, 38 mm high) with 2 pieces of waterlogged wood and enough river water to provide a depth of about 1 cm. The jar lid was screwed on snugly but not tightly, and the jar was placed beneath an inverted 8-oz. glass jar. On Nov. 15, one adult specimen of each species was removed and preserved, as were 19 of the larvae, leaving 1 specimen of *Ancyronyx*, 4 of *Macronychus*, and 2 *Stenelmis* larvae. The *Ancyronyx* and 2 of the *Macronychus* died within 2 years and were removed. When excessive frass has accumulated, it has been removed and clean water added. The wood has been replaced once with "fresh" waterlogged pieces. On August 6, 1971 there was no visible water in the jar, though the wood was still slightly moist; water was added. As of the date of writing (January 27, 1973), one adult *Macronychus* and one *Stenelmis* larvae are still alive after more than 39 months of confinement in the small jar. The other larva died during the 39th month.

An incident is worth noting. On June 29, 1972 two adult *Macronychus* were alive and well. On that date, after removal of frass, I added enough water so that the depth was about 15 mm, which submerged the wood. Prior to that time I had always taken care that part of the wood should be exposed. When I examined the jar contents on July 23, one of the *Macronychus* was dead (though not at all disintegrated), the other apparently moribund. I removed the dead specimen and enough of the water so that the wood was again well exposed. Several days later, the surviving beetle appeared to have recovered. Cole did not happen to indicate whether the vial in which his *Stenelmis* was kept remained upright, though his mention of the fact that the vial "became buried under papers for weeks at a time" (on his desk) would suggest that it very likely lay upon its side. If so, the beetle would have had the opportunity to climb on the cork to or above the water surface, which might well have made the difference between life and death.

Cole estimated that the temperature in his office was "unquestionably above 100°F for several days." Without bragging about Oklahoma weather, I think I can safely make the same assumption about the temperature in my office-lab for more than several days during more than one summer. I might point out, however, that I made no deliberate attempt to reduce or limit the oxygen available to the beetles. The lid on the small jar and the

inverted jar over the small one were intended primarily to retard evaporation, which would pose a serious hazard during my absence for periods of a month or two.

On pieces of half-submerged waterlogged wood in glass culture dishes of river water, most of 22 *Ancyronyx* adults collected near Hodgen, Oklahoma on Oct. 7, 1967 lived more than a year in the refrigerator, but all were dead by June of 1969. The survival rate was about the same in plastic snap-cap vials containing wood extending above the water surface.

On May 28, 1969 I collected an assortment of dryopoids from Devil's River about 20 miles south of Juno, Texas. Hoping to induce pupation, I selected a number of apparently mature larvae to rear in the laboratory. I placed 10 larvae of the limnichid *Lutrochus luteus* Le Conte, 12 larvae of the elmids *Elsianus texanus* Schaeffer, and 18 larvae of the elmids *Neocylloepus boeseli* Brown in a small widemouth plastic jar (49 mm diameter) with travertine-encrusted pebbles and a film of water. The jar was covered by a larger inverted glass jar. Of the *Lutrochus*, 2 pupated successfully; some of the remaining larvae lived until mid-September. By October 26, all but one of the *Neocylloepus* larvae had died. At that time it, too, was preserved, as were 4 of the surviving 7 *Elsianus* larvae. Of the remaining 2 *Elsianus* larvae in the jar, all were still alive on July 25, 1970. By May 30, 1971, only one remained alive, having survived over 2 years in the jar. None of these elmids pupated, though a few larvae of *Microcylloepus pusillus* (Le Conte) have pupated successfully under similar conditions.

In an aerated 10-gallon aquarium containing sand, rocks, waterlogged wood, and assorted aquatic plants (chiefly *Potamogeton* sp.), some species of elmids seem to survive almost indefinitely. Two adult specimens of *Macronychus* and a few of *Microcylloepus* have been in such an aquarium in my home office for almost 10 years now, and appear to be as lively and healthy as ever. Adults of *Dubiraphia* sp. and *Heterelmis vulnerata* (Le Conte) have also survived in the aquarium for several years. *Dubiraphia*, and to a lesser extent *Microcylloepus*, are likely to be accidentally lost during periodic removal of excess plants. Larvae, apparently mature when placed in the aquarium, also seem to survive almost indefinitely—without pupating. Such retarded

larvae include those of *Macronychus*, *Microcylloepus*, and *Stenelmis*.

Mature larvae of *Psephenus herricki* (De Kay), the common eastern water penny, readily pupate in this same aquarium on the projecting rocks, but immature larvae fail to mature. Mature larvae are equally obliging under almost any circumstances so long as the humidity is maintained at a suitable level and the substrate is satisfactory. If the humidity is too high, fungi commonly destroy the pupae; if it is too low, desiccation may be lethal. Covered fingerbowls containing damp rocks serve well as pupation chambers for water pennies, as do styrofoam minnow buckets. Mature larvae of *Ectopria* and of the limnichid *Lutrochus* can also be reared successfully in similar containers. Prepupal larvae and pupae of such elmids as *Macronychus*, *Microcylloepus*, and *Stenelmis* have been reared with a lower success rate. They generally require facilities for construction of a small pupal chamber. In the field, these pupae are usually found under stream-side rocks, beneath bark of logs projecting from streams, or in dead leaves and debris caught on snags during high water and left exposed after receding of the water.

For serious attempts at rearing, I recommend the following set-up (Fig. 1). In a 10-gallon aquarium, cover the bottom with a layer of soil about 1-2 cm deep, cover this with a layer of fine sand about 2-3 cm deep, then add an upper layer of coarse sand or fine gravel about 2 cm deep. Near one end of the aquarium place a large rock with a relatively flat, horizontal upper surface. Sprinkle this upper surface with coarse sand. Place a second flat rock upon the top of the large one. Sprinkle its upper surface with more coarse sand and cover with a third flat-bottomed rock. The spaces between these rocks should provide pupation sites. Place a long, flat piece of native stone or waterlogged wood (depending upon the substrate preference of the species you wish to rear) with one end resting upon the gravel and the other upon the large rock. Submerged aquatic plants may be rooted in the bottom if desired. Fill with pond or stream water to a level just below the top of the large rock. Locate aerators or bubblers beneath the lower end of the long flat rock (or piece of wood) in such a way that the bubbles of air move along the length of the rock or wood, creating a current in the water. Cover the aquarium with glass or plastic so

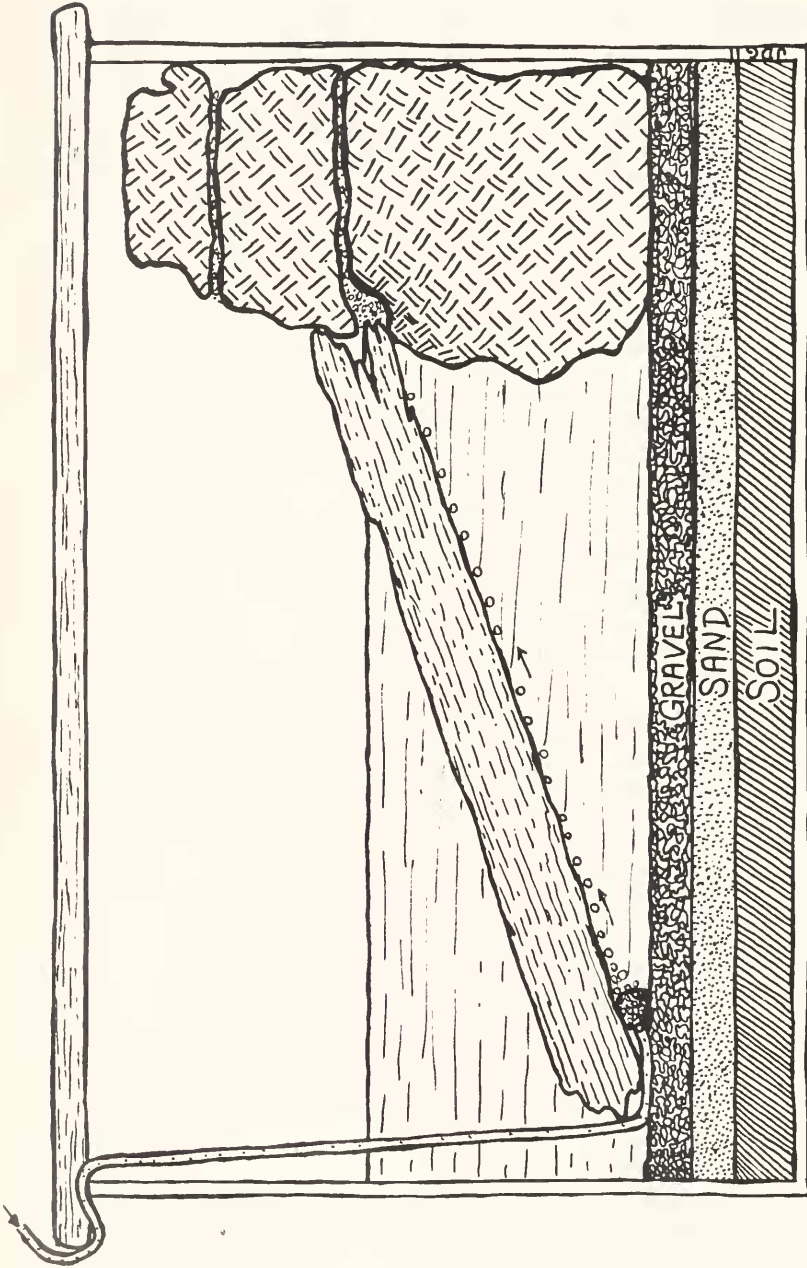


Fig. 1.

Diagram of aquarium set up for rearing dryopoid beetles. Bubbles from the aerator travel up the length of the oblique piece of waterlogged wood or stone, creating a current of water. Prepupal larvae may crawl up to pupation sites between the upper rocks. The rocks are kept slightly apart by scattered grains of coarse sand.

as to reduce water loss. Introduce larval or adult beetles about a week after setting up the aquarium.

It might be well to reiterate that if wood is to be used, either in a jar or in an aquarium, it should be waterlogged—preferably in running water. It has been my experience that other wood, whether green, cured, or rotten has befouled the water, often killing the beetles within a few days. Perhaps dry wood that has previously been waterlogged would be safe to use. I have not tried it. It is best to use wood and/or rocks taken from the natural habitat of the beetles, where these substrates will have acquired a suitable algal flora upon which the beetles may feed.

I make no claim that any of my data represent normal longevity, but, like Cole's most interesting observations, these "endurance records" suggest the remarkable ability of several kinds of elmids to survive inhospitable conditions and to survive in a marginal habitat over surprisingly long periods of time. This hardiness appears to be exhibited almost equally by larval and adult stages. Other groups of dryopoids with which I am familiar do not exhibit this pattern. Psephenid adults, for example, are quite short-lived in contrast with their hardy, long-lived water penny larvae (Murvosh, 1971). The pattern among limnichids, eubriids (if one chooses to distinguish the false water pennies from both psephenids and dascillids), and even elmids of the tribe Larini (or Potamophilini) is similar to that of psephenids. All of these differ from the common elmids (tribe Elmini) in that the adults are essentially terrestrial or riparian rather than aquatic.

The data presented above support and extend the noteworthy features pointed out by Cole: (1) these tiny beetles have a potential adult (and larval) longevity of many years; (2) despite the fact that they normally occur only in flowing, well-oxygenated streams, they can survive environmental extremes comparable to those occurring in ponds, pools, or even puddles.

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ABSTRACT.—Although elmids typically occur only in flowing streams—usually in riffles—*Macronychus glabratus* and *Microcylloepus pusillus* adults and larvae have lived in an aquarium for over 9 years. *Dubiraphia* sp. and *Heterelmis vulnerata* adults have lived in the aquarium several years. An adult of *Macronychus* and a larva of *Stenelmis* sp. have survived in a small (8 dram) plastic jar for more than 39 months, with waterlogged wood as food and a water depth of about 1 cm. Adults of the elmids *Macronychus*, *Microcylloepus*, and *Stenelmis*, the limnichid *Lutrochus*, and the psephenid *Psephenus* have been reared from prepupal larvae and pupae in various small containers. A recommended aquarium set-up is described and figured, featuring a water current produced by air bubbles and pupation sites above the water level provided by flat rocks separated by scattered coarse sand grains.—Harley P. Brown, Dept. of Zoology, Univ. of Okla., 730 Van Vleet Oval, Norman, Oklahoma 73069.

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ERRATA

- Vol. 84 (7) July 1973—Front cover; Table of Contents, "A New Host Record for the Parasitic Rove Beetle *Aleochara bipustulata* L. (Coleoptera:Staphylinidae) p. 210. This article did not appear in this issue but on p. 250 of the October issue.
- Vol. 84 (8) October 1973—Front cover; Table of Contents, "Reproductive Biology and Dulotic Ants" should read, "Reproductive Biology in Dulotic Ants."
- p.250 — **ABSTRACT:**—*Metaleuctra flinti* should be *Megaleuctra flinti*.
- p. 254 — line 8. "Isave" should read "slave."
- p.268. In the article, "Interaction Between A Western Harvester Ant and a Great Basin Sagebrush Lizard," line 4, "the head of a western ant" should read, "The head of a western harvester ant."